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Ocean pout

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1.0 Background

Ocean pout, *Zoarces americanus*, are assessed as a unit stock from Cape Cod Bay south to Delaware. An index assessment for this species was last reviewed at the 2005 Groundfish Assessment Review Meeting (Wigley and Col 2005). At that time, the three year average spring biomass index (2002-2004 average = 1.78 kg/tow) was below the biomass threshold ($\frac{1}{2}$ Bmsy = 2.4 kg/tow) of the Bmsy proxy (1980-1991 median = 4.9 kg/tow). The relative exploitation ratio (0.003) indicated that fishing mortality was well below the F threshold (Fmsy proxy = 0.31). Ocean pout are included in the New England Fishery Management Council's Multispecies Fishery Management Plan and is one of twelve species listed in the "Large Mesh/Groundfish" group based on fish size and type of gear used to harvest the fish.

2.0 The Fishery

From 1964 to 1974, an industrial fishery developed for ocean pout, and nominal catches by the U.S. fleet averaged 4,700 mt (Table O.1, Figure O.1). Distant-water fleets began harvesting ocean pout in large quantities in 1966, and total nominal catches peaked at 27,000 mt in 1969. Foreign catches declined substantially afterward, and none have been reported since 1974. United States landings declined to an average of 600 mt annually during 1975 to 1983. Catches increased in 1984 and 1985 to 1,300 mt and 1,500 mt respectively, due to the development of a small directed fishery in Cape Cod Bay supplying the fresh fillet market. Landings have declined more or less continually since 1987. In recent years, landings from the southern New England/Mid-Atlantic area have continued to dominate the catch, reversing landing patterns observed in 1986-1987, when the Cape Cod Bay fishery was dominant. The shift in landings is attributed to the changes in management (gear/mesh) regulations. Total landings in 2006 were 5 mt, a near record low in the time series (Table O.1, Figure O.1).

Dock-side sampling of commercial ocean pout landings began in 1984 (Appendix Table O.1); landed ocean pout range between 40 and 90 cm, with most fish between 50 and 60 cm. In recent years, dock-side sampling has been sporadic.

Discard Estimation

The primary reason reported in the Northeast Fisheries Observer Program¹ (NEFOP) for ocean pout discards is "no market". Limited NEFOP data are available for gear types other than otter trawl, gillnet and scallop dredge gear. A combined ratio estimator, discard weight of ocean pout to kept weight of all species, was used to estimate ocean pout discards in the otter trawl fishery by large ($>=5.5$ inch) and small (<5.5 inch) mesh groups, gillnet, and scallop dredge using the NEFOP data from the Cape Cod Bay, Georges Bank and Southern New England and Mid-Atlantic regions². Total discards were derived by expanding the discard ratios by the kept weight of all species, by gear type and mesh group, using the Dealer weighout data for 1989 – 2006 (Appendix Tables O.2 and O.3).

Prior to 1989, ocean pout discards were estimated use the survey-scale method (as described in Palmer et al. 2008) utilizing an average combined ratio based on 2004 to 2006 NEFOP data, the NEFSC spring survey weight per tow indices, and the kept weight of all species. Ocean pout

¹ Northeast Fisheries Observer Program was implemented in 1989.

² statistical areas (514, 521, 522, 561, 562, 525, 256, 537-539, 611-616).

discards (mt) were derived for four fleets (large-mesh otter trawl, small-mesh otter trawl, gillnet and scallop dredge) from 1968 – 1988 (Table O.2). The majority of ocean pout discards occur in the large-mesh and small-mesh otter trawl fisheries. Total discards range between 230 mt in 2006 to 10,134 mt in 1990 (Table O.2 and Figure O.1). Discards from each fleet exceed landings in most years (Tables O.1 and O.2).

3.0 Research Survey Indices

Commercial landings and the NEFSC spring research vessel survey biomass index followed similar trends during 1968 to 1975 (encompassing peak levels of foreign fishing and the domestic industrial fishery); both declined from very high values in 1968-1969 to lows of 300 mt and 1.3 kg per tow, respectively, in 1975 (Table O.3 and Figure O.1). Between 1975 and 1985, survey indices increased to record high levels, peaking in 1981 and 1985. Since 1985, survey catch per tow indices have generally declined, and the 2007 index (0.48 kg/tow) is the lowest value in the time series. Both NEFSC winter survey and the Massachusetts Division of Marine Fisheries inshore research vessel surveys confirm the declining trend observed in the NEFSC spring survey (Appendix Tables O.5 and O.6, Appendix Figures O.5 and O.6). Decreases in maximum size can be observed in the NEFSC spring survey length frequencies over time (Appendix Figure O.3).

Survey conversion factors

There are no significant net or door conversion factors for ocean pout, however, there are significant vessel conversion factors for ocean pout (Byrne and Forrester 1991). Vessel conversion factors for numbers and weight are 0.70 and 0.69 (p-value 0.004), respectively. The vessel conversion factors were based upon 510 paired tows from five experiments conducted in the Mid-Atlantic, Southern New England, Georges Bank, and Gulf of Maine regions during the autumn, with the exception of 40 paired tows that were conducted during February. These experiments are spatially appropriate for this species; however, the temporal aspect is problematic. The availability of ocean pout to the otter trawl gear is very different between spring and autumn due to the life history behavior of ocean pout to nest-guard their egg masses in rocky areas during the autumn. In the autumn, ocean pout are not as available to the otter trawl gear as in the spring (Appendix Figure O.4). Given this, the NESFC spring survey is used to monitor trends for this species. Since the majority of paired tows during these experiments took place in the autumn when breeding behavior is occurring and relatively low numbers of ocean pout are caught, it is questionable whether it is appropriate to apply the vessel conversion factors to the NEFSC spring survey. In this assessment, the vessel conversion factors have been applied as an ‘alternative’ series for comparison purposes only. Trends in survey catch with vessel conversion factors are given in Appendix Table O.7 and Appendix Figure O.5.

4.0 Assessment Results

In the previous assessment, the data for ocean pout had insufficient dynamic range over the time series to provide estimates for biological reference points; however, for this assessment, the AIM model was explored using catch through 2006 and a three-year centered average of the NEFSC spring biomass (kg/tow) index through 2007. Exploratory analyses were conducted to evaluate the effect of using survey vessel conversion factors and the sensitivity of the discard estimates. Two series of analyses were conducted, with and without vessel conversion factors. Each series used a range of catch values: landings only, catch (landings and discards), catch derived using

half of the discard estimate, and catch derived using twice the discards. Similar to the previous AIM analyses (NEFSC 2002), all AIM runs were non-informative to base recommendation for Bmsy, Fmsy and MSY (Appendix Table O.8 and Appendix Figure O.6).

Exploratory analyses were also conducted using an age-structured biomass dynamic model (LOSS; Palmer and Legault 2008). Analyses were conducted using a range of values for stock-recruit steepness, stock depletion (S_1/S_0) and initial stock size while holding other input parameters constant. Natural mortality was assumed constant (0.2); mean weights-at-age, maturity-at-age, fishing selectivity and index selectivity were estimated for ocean pout based on information provided within FISHBASE. These results were also non-informative, with little change occurring in the objective function with large changes in reference points and stock status (Appendix Tables O.9a and O.9b).

Relative Exploitation Rate

Computing survey biomass indices of exploitable biomass for use in calculating exploitation ratio was explored. However, given no minimum fish size, no market demand, no mesh selection parameters, and limited commercial length frequency data, there was insufficient information to apply a selection ogive to the ocean pout survey length frequency data.

Exploitation ratios were derived using catch (landings and discards) divided by the three year average of NEFSC spring survey biomass indices (without vessel conversion factors applied). Exploitation ratios have declined sharply from a peak in 1973 to low levels in the early 1980s then increased slightly in the late-1980s, after which they declined to record low levels (Table O.4, Figure O.2). The 2006 exploitation index is 0.46. Exploitation ratios derived using the survey biomass indices adjusted by the vessel conversion factor are presented in Appendix Table O.9.

5.0 Biological Reference Points

Biological reference point proxies were first established for ocean pout by the Overfishing Definition Panel (Applegate et al. 1998). The Overfishing Definition Panel visually inspected the landings and survey trends and chose values for MSY and Bmsy that appeared to be sustainable. The Bmsy proxy (4.9 kg/tow) was based on the 1980-1991 median NEFSC spring survey biomass index. The MSY=1,500 mt was chosen because stock biomass appears to decline when landings exceeded this level (Applegate et al. 1998). MSY was based on landings, not catch. Fmsy proxy (0.31) was derived from the MSY and Bmsy proxy.

With discards estimated in this assessment, biological reference point proxies were updated using catch. The median NEFSC 3yr average spring biomass index (4.94 kg/tow) and the median exploitation ratio (0.76) during 1977-1985 are used as Bmsy and Fmsy proxies, respectively. The 1977-1985 time period corresponds to the time when the replacement ratio was above 1 and biomass increased (Appendix Figure O.6). Based on these proxies, MSY is estimated to be 3,754 mt ($4.94 * 0.76 * 1000$). An alternative set of biological reference point proxies are provided using catch derived with only half of the discard estimate. Given below are biological reference point proxies used in GARM 2005 and re-estimated proxies for GARM 2008. Also provided are proxies that use the NEFSC 3yr average spring biomass index with vessel conversion factor applied.

	GARM 2005 using landings	GARM 2008 using catch	GARM 2008 Alternative using catch with $\frac{1}{2}$ discards
without survey vessel conversion factors	Bmsy = 4.9 kg/tow Fmsy = 0.31 MSY = 1,500 mt	Bmsy = 4.94 kg/tow Fmsy = 0.76 MSY = 3,754 mt	Bmsy = 4.94 kg/tow Fmsy = 0.50 MSY = 2,470 mt
with survey vessel conversion factors	Bmsy = 3.9 Fmsy = 0.39 MSY = 1,500 mt	Bmsy = 4.25 kg/tow Fmsy = 0.76 MSY = 3,230 mt	Bmsy = 4.25 kg/tow Fmsy = 0.57 MSY = 2,422 mt

6.0 Summary

The index assessment presented above reveals that landings, survey indices and exploitation ratios remain at, or near, record low levels and the annual estimates of discards exceeds the landings. Although exploitation has been low, stock size has not increased. Discards are estimated to be an important component of catch and may be sufficiently high to hinder recovery of the stock.

For ocean pout, the replacement ratio and relative F analyses, as well as age-structured biomass dynamics model analyses, were not informative upon which to base Bmsy, Fmsy, and MSY. Thus, biological reference points for ocean pout remain based upon research vessel survey biomass trends and the exploitation history based on total catch.

The three year average of NEFSC spring survey indices and the exploitation ratio (2006 catch / average of 2005, 2006, 2007 spring survey biomass indices) were used as proxies for biomass and fishing mortality, respectively. In 2006, the three year average survey index is (0.51 kg/tow) and the exploitation ratio is 0.46.

7.0 Sources of Uncertainty

- Due to the lack of commercial length samples (one sample of 37 fish since 2004), the size composition of the commercial landings could not be characterized.
- Biological reference points are based on catch; the estimated discards used in catch are based on mix of direct and indirect methods. The catch used to determine MSY is based on indirect methods.

8.0 Acknowledgements

We would like to recognize and thank all those who diligently collected data from the commercial fisheries (port and at-sea) and the research vessel surveys. We thank Jessica Blaylock for her assistance. We thank all the members of the Groundfish Assessment Review

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9.0 References

Applegate, A., S.X. Cadin, J. Hoenig, C. Moore, S. Murawski, and E. Pikitch. 1998. Evaluation of existing overfishing definitions and recommendations for new overfishing definitions to comply with the Sustainable Fisheries Act. New England Fishery Management Council Report.

Byrne, C.J. and J.R.S. Forrester. 1991. *In:* NEFSC. 1991. Report of the Twelfth Northeast Regional Stock Assessment Workshop (12th SAW). Northeast Fisheries Science Center Reference Document 91-03, Northeast Fisheries Science Center, Woods Hole, Massachusetts.

NEFSC [Northeast Fisheries Science Center]. 2002. Final Report of the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish.

Palmer, M., L. O'Brien, R. Mayo, P. Rago and L. Hendrickson. 2008. A brief description of discard estimation where observer coverage is unavailable. Working Paper 4.5, Biological Reference Point Meeting - Groundfish Assessment Review Meeting April 28-May 2, 2008. Woods Hole, MA.

Palmer M. and C. Legault. 2008. Sensitivity of the Long-term Observation-error Survey Series (LOSS) model to variable stock-recruit steepness and stock depletion inputs: A test case using Gulf of Maine haddock. Working Paper 4.3, Biological Reference Point Meeting - Groundfish Assessment Review Meeting April 28-May 2, 2008. Woods Hole, MA.

Wigley, S. and L. Col. 2005. *In:* Mayo, R.K and Terceiro, M. editors, 2005. Assessment of 19 Northeast groundfish stocks through 2004. 2005 Groundfish Assessment Review Meeting (2005 GARM), Northeast Fisheries Science Center, Woods Hole MA, 15-19 August 2005. *U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc.* 05-13, 499 p.

Table O.1. Commercial landings and discards (mt, live) of ocean pout from the Gulf of Maine to the Mid-Atlantic region (NAFO Subareas 5 and 6), 1962-2006, and preliminary 2007.

Year	USA Landings			Other Landings	Total Landings	Discards	Total Catch
	5	6	Total				
1962	0	0	0	0	0		0
1963	20	0	20	0	20		20
1964	2123	0	2123	0	2123		2123
1965	877	0	877	0	877		877
1966	7149	0	7149	6231	13380		13380
1967	7090	0	7090	271	7361		7361
1968	8373	364	8737	4324	13061	3438.8	16500
1969	5571	966	6537	20435	26972	3095.1	30067
1970	5851	426	6277	895	7172	2735.4	9907
1971	2678	1448	4126	1784	5910	1999.3	7909
1972	1927	358	2285	1066	3351	1481.7	4833
1973	2810	285	3095	2275	5370	1279.9	6650
1974	2790	459	3249	483	3732	1121.5	4853
1975	209	65	274	3	277	708.7	986
1976	341	337	678	0	678	516.5	1194
1977	809	250	1059	0	1059	918.0	1977
1978	715	320	1035	0	1035	1362.6	2398
1979	658	14	672	0	672	1492.9	2165
1980	339	11	350	0	350	1994.1	2344
1981	234	17	251	0	251	2713.6	2965
1982	317	4	321	0	321	4419.8	4741
1983	408	0	408	0	408	4484.6	4893
1984	1324	0	1324	0	1324	3692.6	5017
1985	1450	54	1504	0	1504	3160.8	4665
1986	801	1	802	0	802	3293.7	4096
1987	2111	74	2185	0	2185	2622.5	4808
1988	1765	46	1811	0	1811	2242.3	4053
1989	1308	6	1314	0	1314	8632.3	9946
1990	1299	13	1312	0	1312	10134.2	11446
1991	1361	63	1424	0	1424	6229.0	7653
1992	406	68	474	0	474	1824.3	2298
1993	217	15	232	0	232	1573.3	1805
1994	137	59	196	0	196	1714.6	1911
1995	51	14	65	0	65	685.3	750
1996	34.7	16.3	51.0	0	51	760.0	811
1997	7.6	25.4	33.0	0	33	573.7	607
1998	8.6	8.4	17.0	0	17	798.3	815
1999	8.9	9.1	18.0	0	18	926.9	945
2000	8.4	10.6	19.0	0	19	390.4	409
2001	8.4	9.2	17.6	0	18	577.6	595
2002	3.5	8.6	12.1	0	12	611.6	624
2003	18.1	7.4	25.6	0	26	471.0	497
2004	3.0	2.4	5.4	0	5	363.3	369
2005	0.6	3.0	3.6	0	4	274.9	279
2006	0.2	4.9	5.1	0	5	230.3	235
2007					3		

Table O.2. Ocean pout discards (mt) and coefficient of variation from the large-mesh (\geq 5.5 inches) otter trawl, small-mesh (<5.5 inches) otter trawl, gillnet, and scallop dredge fleets, 1968 – 2006. A combined ratio estimator of ocean pout discard to kept of all species based on NEFOP data is used to estimate discards from 1989 to 2006. The survey scale method is used to estimate discards prior to 1989.

YEAR	Large-mesh Otter Trawl		Small-mesh Otter Trawl		Gillnet		Scallop Dredge		Total	
	mt	CV	mt	CV	mt	CV	mt	CV	mt	CV
1968			3432.2		1.1		5.5		3438.8	
1969			3090.7		0.9		3.5		3095.1	
1970			2731.2		0.9		3.3		2735.4	
1971			1996.2		0.6		2.5		1999.3	
1972			1479.5		0.8		1.4		1481.7	
1973			1278.0		0.6		1.4		1279.9	
1974			1119.1		0.8		1.6		1121.5	
1975			706.9		0.3		1.5		708.7	
1976			514.3		0.2		2.0		516.5	
1977			912.8		0.5		4.7		918.0	
1978			1354.4		1.4		6.9		1362.6	
1979			1482.7		2.0		8.2		1492.9	
1980			1980.5		5.3		8.3		1994.1	
1981			2694.2		5.8		13.6		2713.6	
1982	2115.8		2282.7		6.6		14.8		4419.8	
1983	3316.4		1148.4		6.3		13.5		4484.6	
1984	2996.5		679.4		7.3		9.4		3692.6	
1985	2513.1		629.8		7.7		10.2		3160.8	
1986	2427.0		841.6		10.9		14.2		3293.7	
1987	2007.7		590.5		7.8		16.6		2622.5	
1988	1685.8		535.4		7.0		14.1		2242.3	
1989	5275.6	0.33	3342.1	0.46	0.2	1.48	14.4		8632.3	0.27
1990	9306.1	0.31	806.4	0.39	2.1	1.41	19.6		10134.2	0.29
1991	3500.4	0.43	2703.9	0.37	4.8	0.55	19.9		6229.0	0.29
1992	1291.4	0.36	318.6	0.42	4.3	0.27	210.0	0.57	1824.3	0.27
1993	1038.7	0.28	240.6	0.58	5.9	0.41	288.2	0.34	1573.3	0.21
1994	484.7	0.40	1103.3	4.52	7.0	0.92	119.6	0.51	1714.6	2.91
1995	453.6	0.34	216.0	0.44	1.1	0.65	14.7	0.41	685.3	0.26
1996	489.6	0.38	210.5	1.09	1.8	0.93	58.2	0.72	760.0	0.39
1997	488.2	0.53	41.9	0.53	5.3	0.55	38.4	0.29	573.7	0.45
1998	686.7	0.66	49.3	0.58	0.5	0.92	61.7	0.74	798.3	0.57
1999	808.8	0.31	62.7	0.69	9.0	0.54	46.4	0.69	926.9	0.27
2000	332.8	0.65	27.0	0.48	17.7	0.70	12.9	0.27	390.4	0.56
2001	521.0	0.36	40.1	0.43	2.1	0.58	14.4	0.40	577.6	0.33
2002	563.7	0.33	35.3	0.35	4.8	0.55	7.8	0.56	611.6	0.31
2003	402.1	0.17	48.4	0.37	4.9	0.35	15.6	0.29	471.0	0.15
2004	268.7	0.12	88.4	0.33	3.9	0.33	2.3	0.56	363.3	0.12
2005	167.6	0.09	101.3	0.19	2.1	0.67	3.8	0.19	274.9	0.09
2006	130.5	0.12	95.1	0.44	0.7	0.86	4.1	0.21	230.3	0.19

Table O.3. Stratified mean catch per tow in weight and numbers, individual average fish weight, and mean length and of ocean pout in **NEFSC spring surveys without conversion factors applied**, in the Gulf of Maine-Mid-Atlantic region (strata 1-26, 73-76), 1968-2007.

<i>without vessel conversion factors</i>				
Year	Mean weight per tow (kg)	Mean number per tow	Individual average weight (kg)	Mean length (cm)
1968	5.446	6.768	0.805	51.1
1969	6.154	8.629	0.713	49.3
1970	5.143	6.133	0.839	51.9
1971	2.195	3.135	0.700	50.2
1972	4.463	5.104	0.874	51.6
1973	3.373	4.591	0.735	48.8
1974	1.479	2.310	0.640	47.0
1975	1.293	1.358	0.952	53.4
1976	1.400	2.440	0.574	46.5
1977	3.605	6.366	0.566	44.8
1978	3.371	11.831	0.285	31.6
1979	1.493	5.197	0.287	34.7
1980	5.729	11.837	0.484	42.6
1981	7.605	14.131	0.538	42.7
1982	4.743	8.690	0.546	44.0
1983	4.236	5.076	0.835	50.5
1984	5.540	7.275	0.762	50.0
1985	6.494	9.011	0.721	48.7
1986	6.345	6.995	0.907	53.0
1987	2.705	3.076	0.879	51.7
1988	3.244	5.405	0.600	45.0
1989	2.792	5.323	0.525	44.0
1990	5.074	6.369	0.797	50.3
1991	3.783	5.596	0.676	49.7
1992	2.257	2.639	0.855	52.9
1993	3.084	3.546	0.870	53.4
1994	2.309	2.640	0.875	54.3
1995	1.916	2.525	0.759	50.5
1996	2.058	3.127	0.658	47.6
1997	1.632	2.069	0.789	52.4
1998	1.733	2.957	0.586	46.1
1999	2.561	3.340	0.767	50.2
2000	2.016	3.113	0.648	48.2
2001	2.798	3.748	0.746	51.6
2002	2.025	2.809	0.721	51.3
2003	2.758	2.919	0.945	55.4
2004	0.546	0.673	0.812	50.8
2005	0.526	0.854	0.616	45.9
2006	0.526	0.789	0.667	47.4
2007	0.477	1.076	0.443	42.9
mean 1968-2007	3.173			
median 1968-2007	2.775			
median 1980 -1991	4.909			

Table O.4. NEFSC spring survey index(kg/tow), total catch ('000 mt), 3 year moving average of spring survey biomass index, relative exploitation rate (catch/ 3 yr average of spring survey biomass index) for ocean pout, 1968 – 2007. No vessel conversion factors applied.

Year	NEFSC Spring Index kg/tow	Total Catch ('000, mt)	3 year moving average (kg/tow)	Exploitation ratio (catch/ 3yr avg index)
1968	5.446	16.4998	5.800	2.845
1969	6.154	30.0671	5.581	5.387
1970	5.143	9.9074	4.497	2.203
1971	2.195	7.9093	3.934	2.011
1972	4.463	4.8327	3.344	1.445
1973	3.373	6.6499	3.105	2.142
1974	1.479	4.8535	2.048	2.369
1975	1.293	0.9857	1.391	0.709
1976	1.400	1.1945	2.099	0.569
1977	3.605	1.9770	2.792	0.708
1978	3.371	2.3976	2.823	0.849
1979	1.493	2.1649	3.531	0.613
1980	5.729	2.3441	4.942	0.474
1981	7.605	2.9646	6.026	0.492
1982	4.743	4.7408	5.528	0.858
1983	4.236	4.8926	4.840	1.011
1984	5.540	5.0166	5.423	0.925
1985	6.494	4.6648	6.126	0.761
1986	6.345	4.0957	5.181	0.791
1987	2.705	4.8075	4.098	1.173
1988	3.244	4.0533	2.914	1.391
1989	2.792	9.9463	3.703	2.686
1990	5.074	11.4462	3.883	2.948
1991	3.783	7.6530	3.704	2.066
1992	2.257	2.2983	3.041	0.756
1993	3.084	1.8053	2.550	0.708
1994	2.309	1.9106	2.436	0.784
1995	1.916	0.7503	2.094	0.358
1996	2.058	0.8110	1.869	0.434
1997	1.632	0.6067	1.808	0.336
1998	1.733	0.8153	1.975	0.413
1999	2.561	0.9449	2.103	0.449
2000	2.016	0.4094	2.458	0.167
2001	2.798	0.5952	2.280	0.261
2002	2.025	0.6237	2.527	0.247
2003	2.758	0.4966	1.777	0.280
2004	0.546	0.3687	1.277	0.289
2005	0.526	0.2789	0.533	0.523
2006	0.526	0.2353	0.510	0.462
2007	0.477			
2008				
time series average	3.24		3.24	1.13
time series median	2.79		2.91	0.76
1980-91 median			4.89	0.97
1977-85 median			4.94	0.76

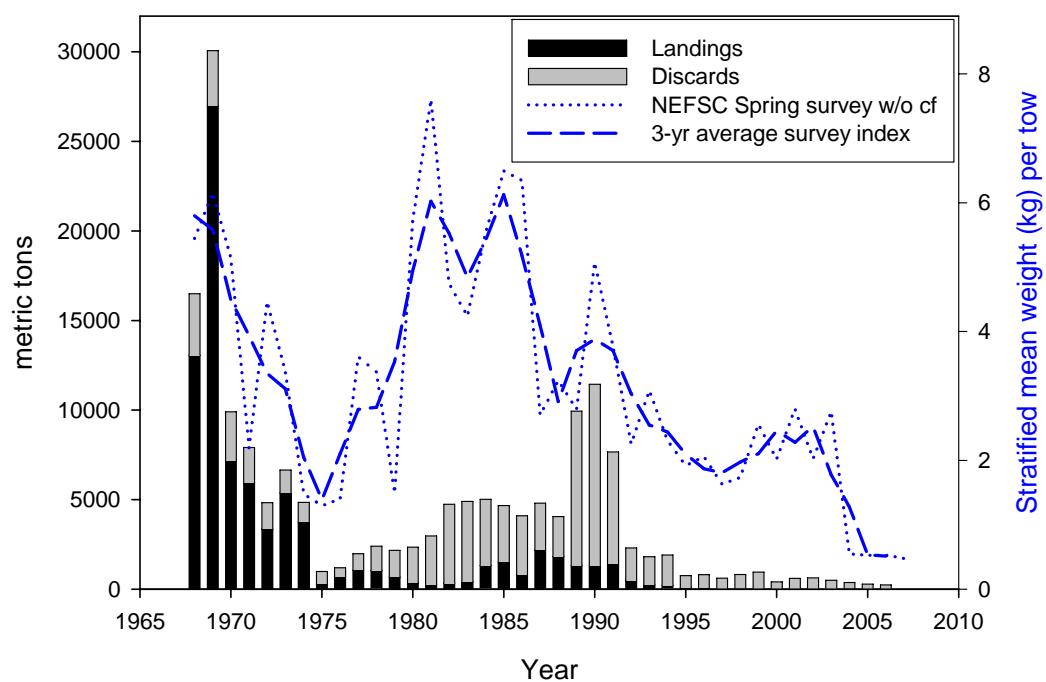


Figure O.1. Trends in landings (mt), discards (mt) and NEFSC spring survey biomass (kg/tow) for ocean pout, 1968 – 2006.

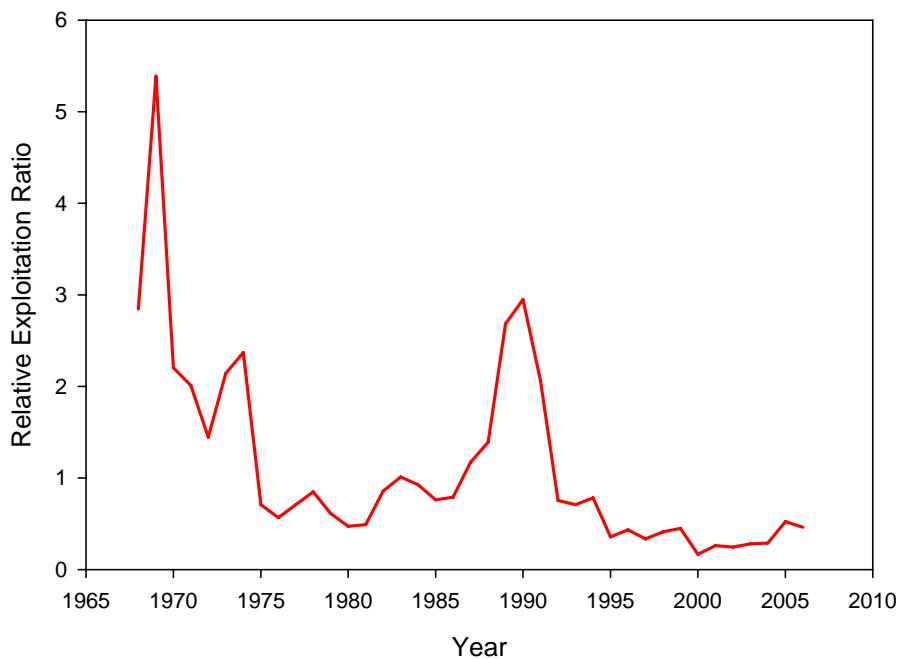


Figure O.2. Relative exploitation ratio (catch / 3-yr average of spring biomass index) for ocean pout, 1968 – 2006.

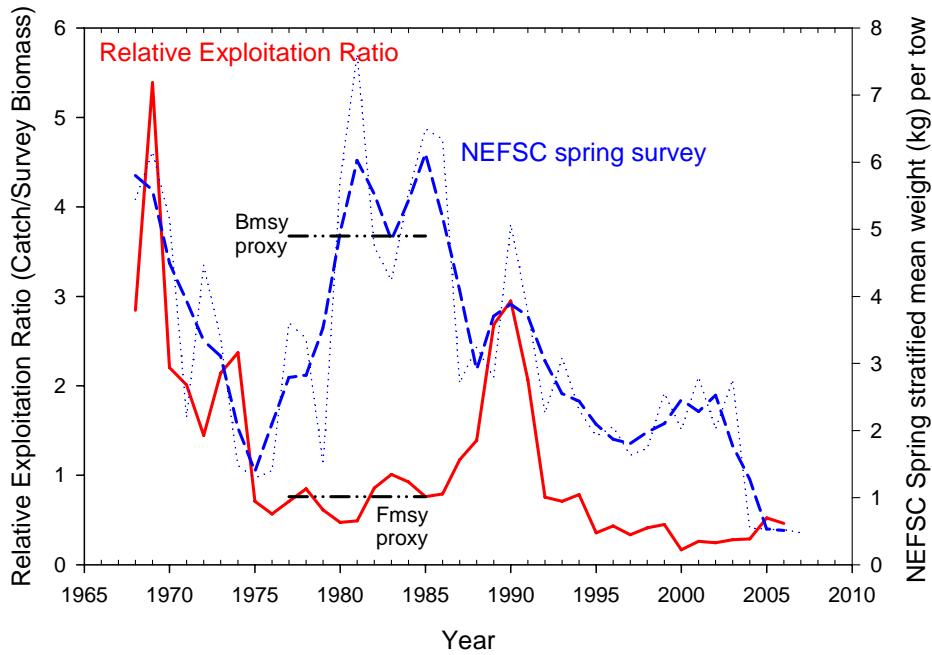


Figure O.3. Relative exploitation rate (catch / 3-yr average of spring biomass index) and NEFSC spring survey weight (kg) per tow for ocean pout, 1968 – 2006.

Appendix Table O.1. Number of commercial lengths (individual fish measured) and number of samples for ocean pout collected during 1969 to 2007, by calendar quarter.

Year	Q1	Q2	Q3	Q4	Total	# of Samples
1969					0	
1970					0	
1971					0	
1972					0	
1973					0	
1974					0	
1975					0	
1976					0	
1977					0	
1978					0	
1979					0	
1980					0	
1981					0	
1982					0	
1983					0	
1984		592			592	5
1985	670	335			1005	9
1986	780	458			1238	11
1987	1477	717			2194	19
1988	1093	805		106	2004	17
1989	1283	864			2147	17
1990	1006	112			1118	12
1991	1044	259		93	1396	14
1992	402	181			583	6
1993	93				93	1
1994					0	1
1995		76			76	1
1996				17	17	1
1997					0	0
1998					0	0
1999					0	0
2000					0	0
2001					0	0
2002	109				109	1
2003	136	76			212	4
2004	37				37	1
2005					0	0
2006	133	54			187	4
2007	167	11			178	3

Five commercial age samples have been obtained: 28 fish in 1985; 29 fish in 1989; 53 fish in 1991 (from 2 samples); and 21 fish in 1992.

Appendix Table O.2. Number of observed trips and combined discard ratio of ocean pout discards to kept of all species for selected fleets, 1989 – 2006 using NEFOP data..

YEAR	Large-mesh Otter Trawl		Small-mesh Otter Trawl		Gillnet		Scallop Dredge	
	OB trips	d/k ratio	OB trips	d/k ratio	OB trips	d/k ratio	OB trips	d/k ratio
1989	34	0.07830	91	0.06369	67	0.00001		
1990	43	0.10846	55	0.01482	84	0.00014		
1991	56	0.04104	127	0.04608	448	0.00029		
1992	58	0.01594	74	0.00543	599	0.00024	13	0.00180
1993	27	0.01607	23	0.00385	420	0.00025	20	0.00457
1994	28	0.00795	17	0.01873	195	0.00031	18	0.00205
1995	74	0.00890	77	0.00453	182	0.00004	22	0.00025
1996	44	0.00840	59	0.00367	136	0.00005	35	0.00096
1997	26	0.00924	60	0.00074	152	0.00016	26	0.00076
1998	17	0.01139	34	0.00075	209	0.00001	23	0.00141
1999	33	0.01460	53	0.00123	122	0.00028	28	0.00061
2000	93	0.00576	43	0.00058	137	0.00069	250	0.00012
2001	150	0.00827	59	0.00101	92	0.00009	64	0.00009
2002	197	0.00947	101	0.00110	125	0.00020	84	0.00004
2003	352	0.00659	106	0.00150	418	0.00019	91	0.00008
2004	563	0.00375	312	0.00163	971	0.00014	213	0.00001
2005	1363	0.00300	358	0.00290	787	0.00009	268	0.00002
2006	639	0.00271	185	0.00172	221	0.00004	199	0.00002

mean 2004-2006 0.00315 0.00208 0.00009 0.00002

Appendix Table O.3. Ocean pout discards (mt) and coefficient of variation from the large-mesh otter trawl, small-mesh otter trawl, gillnet, and scallop dredge fleets, 1989 – 2006.

Discards were derived using a combined ratio estimator of ocean pout discard to kept of all species.

YEAR	Large-mesh Otter Trawl		Small-mesh Otter Trawl		Gillnet		Scallop Dredge		Total	
	mt	CV	mt	CV	mt	CV	mt	CV	mt	CV
1989	5275.6	0.333	3342.1	0.457	0.2	1.478			8617.9	0.270
1990	9306.1	0.311	806.4	0.392	2.1	1.405			10114.6	0.288
1991	3500.4	0.434	2703.9	0.366	4.8	0.554			6209.1	0.292
1992	1291.4	0.363	318.6	0.417	4.3	0.275	210.0	0.568	1824.3	0.275
1993	1038.7	0.275	240.6	0.581	5.9	0.412	288.2	0.340	1573.3	0.212
1994	484.7	0.397	1103.3	4.515	7.0	0.916	119.6	0.507	1714.6	2.908
1995	453.6	0.340	216.0	0.439	1.1	0.645	14.7	0.411	685.3	0.264
1996	489.6	0.383	210.5	1.093	1.8	0.933	58.2	0.717	760.0	0.395
1997	488.2	0.531	41.9	0.525	5.3	0.553	38.4	0.289	573.7	0.454
1998	686.7	0.663	49.3	0.581	0.5	0.917	61.7	0.738	798.3	0.575
1999	808.8	0.307	62.7	0.687	9.0	0.543	46.4	0.688	926.9	0.274
2000	332.8	0.649	27.0	0.479	17.7	0.704	12.9	0.271	390.4	0.555
2001	521.0	0.364	40.1	0.430	2.1	0.584	14.4	0.396	577.6	0.330
2002	563.7	0.332	35.3	0.346	4.8	0.547	7.8	0.561	611.6	0.307
2003	402.1	0.167	48.4	0.365	4.9	0.348	15.6	0.287	471.0	0.148
2004	268.7	0.117	88.4	0.328	3.9	0.332	2.3	0.564	363.3	0.118
2005	167.6	0.094	101.3	0.188	2.1	0.669	3.8	0.193	274.9	0.090
2006	130.5	0.117	95.1	0.441	0.7	0.861	4.1	0.210	230.3	0.194

Note: 1989 – 1991 total discard do not include scallop discards.

Appendix Table O.4. Ocean pout discards (mt) from the large-mesh otter trawl, small-mesh otter trawl, gillnet from 1968 - 1988 and scallop dredge fleets from 1968 – 1991 based on the survey scale method.

YEAR	Large-mesh Otter Trawl	Small-mesh Otter Trawl	Gillnet	Scallop Dredge	Total
1968		3432.2	1.1	5.5	3438.8
1969		3090.7	0.9	3.5	3095.1
1970		2731.2	0.9	3.3	2735.4
1971		1996.2	0.6	2.5	1999.3
1972		1479.5	0.8	1.4	1481.7
1973		1278.0	0.6	1.4	1279.9
1974		1119.1	0.8	1.6	1121.5
1975		706.9	0.3	1.5	708.7
1976		514.3	0.2	2.0	516.5
1977		912.8	0.5	4.7	918.0
1978		1354.4	1.4	6.9	1362.6
1979		1482.7	2.0	8.2	1492.9
1980		1980.5	5.3	8.3	1994.1
1981		2694.2	5.8	13.6	2713.6
1982	2115.8	2282.7	6.6	14.8	4419.8
1983	3316.4	1148.4	6.3	13.5	4484.6
1984	2996.5	679.4	7.3	9.4	3692.6
1985	2513.1	629.8	7.7	10.2	3160.8
1986	2427.0	841.6	10.9	14.2	3293.7
1987	2007.7	590.5	7.8	16.6	2622.5
1988	1685.8	535.4	7.0	14.1	2242.3
1989				14.4	
1990				19.6	
1991				19.9	

*Note: Regulatory otter trawl mesh size prior to 1982 was less than 5.5 inches;
1989 – 1991 scallop dredge discards were estimated using this method due to no
observer coverage of this fleet.*

Appendix Table O.5. Stratified mean catch per tow in weight and numbers, mean length and individual average fish weight of ocean pout in **NEFSC winter surveys** (strata 1-3, 5-7, 9-11, 13-14, 73-75), 1992-2007. *No vessel conversion factors applied.*

Year	Mean weight per tow	Individual Mean number per tow	average weight (kg)	Mean length (cm)
	(kg)		(kg)	
1992	34.64	47.29	0.733	51.9
1993	27.86	48.57	0.574	47.1
1994	9.18	15.28	0.601	47.1
1995	7.32	16.92	0.433	43.3
1996	9.68	17.13	0.565	47.2
1997	11.70	21.36	0.548	47.5
1998	4.77	12.63	0.378	40.4
1999	15.44	24.85	0.621	48.3
2000	8.46	18.14	0.466	44.6
2001	13.45	28.01	0.480	46.1
2002	7.94	12.05	0.659	51.1
2003	18.54	20.25	0.916	56.0
2004	9.58	12.89	0.744	49.6
2005	2.84	5.61	0.506	41.3
2006	3.09	7.44	0.415	40.3
2007	1.72	2.43	0.709	48.9

Appendix Table O.6. Stratified mean catch per tow in weight and numbers, individual average fish weight and mean length of ocean pout in **Mass. inshore spring surveys** (strata 25-36), 1978-2007.

Year	Mean weight per tow	Individual		
	Mean number per tow	average weight (kg)	Mean length (cm)	
1978	42.00	107.39	0.391	38.8
1979	47.11	94.79	0.497	39.6
1980	34.42	60.13	0.572	42.9
1981	74.98	125.46	0.598	43.5
1982	61.39	90.50	0.678	47.2
1983	98.69	123.35	0.800	50.2
1984	85.25	147.25	0.579	45.0
1985	96.36	130.93	0.736	47.2
1986	28.46	62.62	0.454	39.4
1987	31.61	66.44	0.476	41.3
1988	26.18	56.71	0.462	39.7
1989	36.40	54.19	0.672	46.8
1990	25.04	38.19	0.656	47.0
1991	21.20	29.08	0.729	49.6
1992	42.43	59.02	0.719	48.5
1993	32.87	46.82	0.702	51.0
1994	22.34	36.73	0.608	46.9
1995	25.75	44.22	0.582	46.5
1996	14.03	26.06	0.538	45.6
1997	13.05	28.04	0.465	41.9
1998	5.56	8.45	0.658	49.7
1999	5.42	8.61	0.630	46.5
2000	16.35	22.22	0.736	49.8
2001	13.27	19.55	0.679	49.9
2002	6.27	10.47	0.599	48.1
2003	4.95	8.42	0.588	47.8
2004	7.66	9.27	0.827	53.0
2005	7.48	9.51	0.787	53.4
2006	6.22	9.03	0.689	49.6
2007	5.58	8.44	0.661	48.6
2008				

Appendix Table O.7. Stratified mean catch per tow in weight and numbers, individual average fish weight and mean length of ocean pout in **NEFSC spring surveys with conversion factors applied**, in the Gulf of Maine - Mid-Atlantic region (strata 1-26, 73-76), 1968-2007.

with vessel conversion factors

Year	Mean weight per tow (kg)	Mean number per tow	Individual average weight (kg)	Mean length (cm)
1968	5.446	6.768	0.805	51.1
1969	6.154	8.629	0.713	49.3
1970	5.143	6.133	0.839	51.9
1971	2.195	3.135	0.700	50.2
1972	4.463	5.104	0.874	51.6
1973	2.753	3.618	0.761	49.3
1974	1.479	2.310	0.640	47.0
1975	1.293	1.358	0.952	53.4
1976	1.170	1.912	0.612	46.9
1977	3.461	6.201	0.558	44.7
1978	3.371	11.831	0.285	31.6
1979	1.096	3.695	0.297	34.9
1980	4.333	8.955	0.484	42.7
1981	5.247	9.891	0.530	42.7
1982	3.273	6.083	0.538	44.0
1983	4.236	5.076	0.835	50.5
1984	5.540	7.275	0.762	50.0
1985	6.494	9.011	0.721	48.7
1986	6.345	6.995	0.907	53.0
1987	2.686	3.065	0.876	51.7
1988	3.244	5.405	0.600	45.0
1989	1.926	3.726	0.517	44.0
1990	3.501	4.459	0.785	50.3
1991	2.610	3.917	0.666	49.7
1992	2.257	2.639	0.855	52.9
1993	3.084	3.546	0.870	53.4
1994	1.593	1.848	0.862	54.3
1995	1.916	2.525	0.759	50.5
1996	2.058	3.127	0.658	47.6
1997	1.632	2.069	0.789	52.4
1998	1.733	2.957	0.586	46.1
1999	2.561	3.340	0.767	50.2
2000	2.016	3.113	0.648	48.2
2001	2.798	3.748	0.746	51.6
2002	2.025	2.809	0.721	51.3
2003	1.903	2.043	0.931	55.4
2004	0.546	0.673	0.812	50.8
2005	0.526	0.854	0.616	45.9
2006	0.526	0.789	0.667	47.4
2007	0.477	1.076	0.443	42.9

mean 1968-2007	2.878
median 1968-2007	2.586
median 1980 -1991	3.869

Appendix Table O.8 Relative F and randomization test results of eight formulations of AIM for ocean pout: with and without vessel conversion factor applied to the survey biomass index and landings, catch, catch calculated using half of the estimated discard, and catch calculated using twice the estimated discard.

<i>without vessel conversion factor</i>				
	Landings	Catch	Catch (0.5xDiscards)	Catch (2xDiscards)
Relative F	564460.60	0.02	0.01	0.03
5%percentile	0.00	0.00	0.00	0.00
95% percentile	745206700000.00	4085.19	43718.27	61560.40
Randomization Test				
Critical Value	0.042	-0.081	-0.086	-0.066
Significant Level	0.732	0.570	0.552	0.608

<i>with vessel conversion factor</i>				
	Landings	Catch	Catch (0.5xDiscards)	Catch (2xDiscards)
Relative F	0.00	0.11	0.05	0.18
5%percentile	0.00	0.00	0.00	0.00
95% percentile	1043285000000.00	1316.51	2201.72	36624.88
Randomization Test				
Critical Value	-0.011	-0.153	-0.154	-0.139
Significant Level	0.626	0.391	0.372	0.438

Appendix Table O.9a. Ocean pout input vectors used in LOSS model exploration.

Input vectors

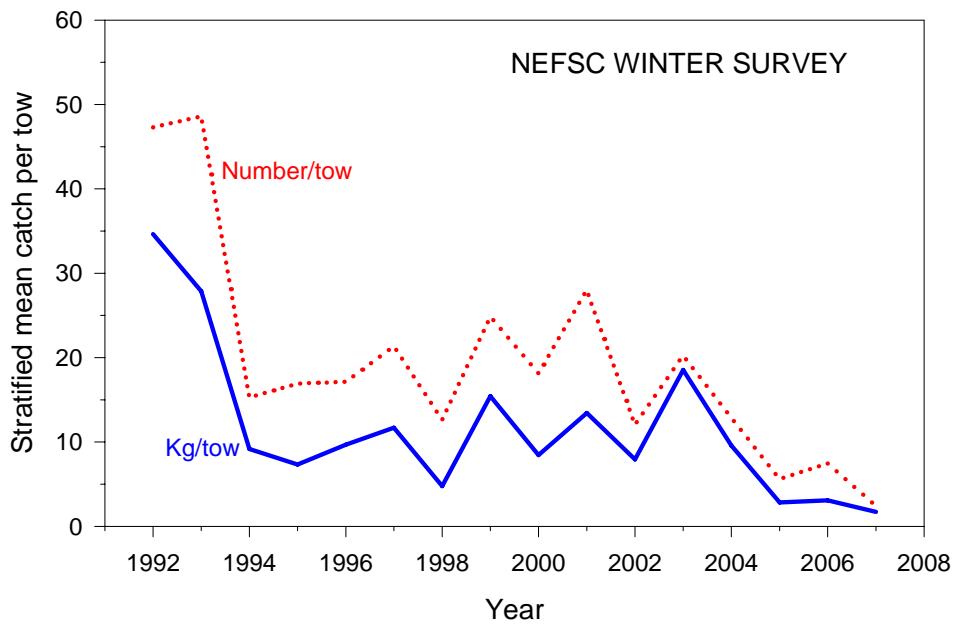
Age	M	Mean			
		weight at age	Maturity at age	Fishing Selectivity	Index Selectivity
1	0.2	0.001	0.1	0.01	0.5
2	0.2	0.008	0.5	0.1	1
3	0.2	0.022	1	0.5	1
4	0.2	0.045	1	1	1
5	0.2	0.075	1	1	1
6	0.2	0.112	1	1	1
7	0.2	0.153	1	1	1
8	0.2	0.199	1	1	1
9	0.2	0.247	1	1	1
10	0.2	0.297	1	1	1
11	0.2	0.347	1	1	1
12	0.2	0.397	1	1	1
13	0.2	0.446	1	1	1
14	0.2	0.494	1	1	1
15	0.2	0.54	1	1	1
16	0.2	0.584	1	1	1
17	0.2	0.626	1	1	1
18	0.2	0.665	1	1	1
19	0.2	0.702	1	1	1
20	0.2	0.737	1	1	1
21	0.2	0.769	1	1	1
22	0.2	0.799	1	1	1
23	0.2	0.827	1	1	1
24	0.2	0.852	1	1	1
25	0.2	0.876	1	1	1
26	0.2	0.898	1	1	1
27	0.2	0.918	1	1	1
28	0.2	0.936	1	1	1
29	0.2	0.953	1	1	1
30	0.2	0.969	1	1	1

Appendix Table O9b. Summary of LOSS model exploration run results with varying steepness, depletion (S1/S0) values and two initial stock sizes (200,000 and 500,000).

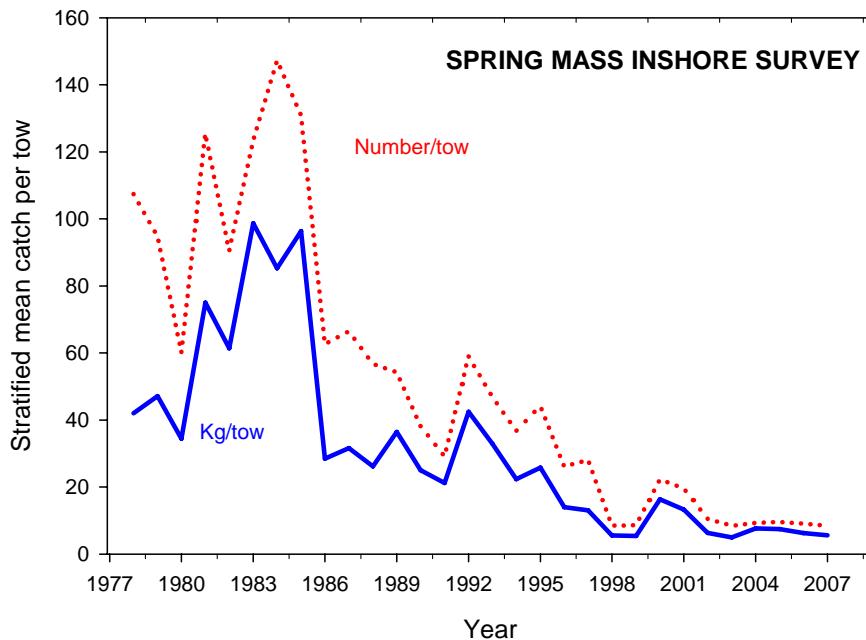
obj_fun	18.9304	18.9808	19.0364	19.0956	19.1582	19.1166	19.1019	19.103	18.9265	18.9272	18.9279	18.9292	18.9304	18.9316
likely_ind	18.9304	18.9808	19.0364	19.0956	19.1582	19.1166	19.1019	19.103	18.9265	18.9272	18.9279	18.9292	18.9304	18.9316
likely_catchwt	0.00	2.98E-10	0.00	6.45E-10	7.43E-10	2.68E-07	3.07E-07	2.45E-07	1.83E-10	1.72E-10	1.61E-10	1.43E-10	0.00	1.12E-10
Fpen	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rmse	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
sigma	0.566	0.595012	0.629	0.667358	0.710524	0.68153	0.67157	0.672339	0.563567	0.563968	0.564354	0.565088	0.566	0.566479
S1/S0	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.20	0.30	0.40	0.60	0.80	1.00
S0	215237	164421	141935	128870	120142	296994	474431	437114	685103	475182	370631	266613	215237	185100
R0	302182	230839	199269	180927	168673	416965	666078	613687	961851	667133	520348	374311	302182	259871
steepness	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95	0.25	0.25	0.25	0.25	0.25	0.25
Fmsy	0.016	0.042	0.066	0.088	0.109	0.131	0.155	0.181	0.016	0.016	0.016	0.016	0.016	0.016
SSBmsy	102380	71907	57774	49144	43060	100107	150123	129231	325877	226026	176295	126817	102380	88045
Fratio	0.33	0.15	0.10	0.07	0.05	0.01	0.00	0.00	0.39	0.38	0.37	0.35	0.33	0.31
SSBratio	0.51	0.60	0.71	0.86	1.05	2.75	3.04	3.25	0.13	0.20	0.26	0.38	0.51	0.62
obj_fun	18.9586	19.041	19.1067	19.1291	3525.1	19.1402	19.1412	3490.36	3.01E+08	1.71E+08	85724800	8413490	18.9586	18.9393
likely_ind	18.9586	19.041	19.1067	19.1291	19.1375	19.1402	19.1412	19.1415	20.2771	20.2588	20.2339	20.0103	18.9586	18.9393
likely_catchwt	7.72E-10	1.05E-10	5.643E-11	4.57E-11	3505.96	3.79E-11	3.56E-11	3471.22	3.01E+08	1.71E+08	85723100	8413470	7.72E-10	8.55E-11
Fpen	0	0	0	0	0	0	0	0	44745.3	22893.7	1595.37	1.3386	0	0
rmse	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
sigma	0.581939	0.631918	0.67486	0.69008	0.695939	0.697847	0.698529	0.698706	2.17506	2.13567	2.08313	1.66583	0.581939	0.570796
S1/S0	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.20	0.30	0.40	0.60	0.80	1.00
S0	200,000													
R0	280790	280790	280790	280790	280790	280790	280790	280790	280790	280790	280790	280790	280790	280790
steepness	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95	0.25	0.25	0.25	0.25	0.25	0.25
Fmsy	0.016	0.042	0.066	0.088	0.109	0.131	0.155	0.181	0.016	0.016	0.016	0.016	0.016	0.016
SSBmsy	95132	87467	81409	76269	71681	67414	63286	59129	95132	95132	95132	95132	95132	95132
Fratio	0.53	0.06	0.03	0.02	0.01	0.01	0.01	0.01	319.93	320.05	320.09	320.53	0.53	0.23
SSBratio	0.34	1.19	1.75	2.11	2.38	2.61	2.83	3.08	0.00	0.00	0.00	0.00	0.34	0.78
obj_fun	19.0478	19.0928	19.1015	19.1029	55473700	19.1016	24470	59.5129	18789000	18.9398	19.0255	19.0556	19.0478	2278070
likely_ind	19.0478	19.0928	19.1015	19.1029	19.0952	19.1016	19.1008	19.1	20.1336	18.9398	19.0255	19.0556	19.0478	19.0346
likely_catchwt	7.87E-12	4.79E-12	4.119E-12	3.8E-12	55473700	3.46E-12	24450.9	40.4129	18789000	1.81E-10	6.44E-11	1.59E-11	7.87E-12	2278050
Fpen	0	0	0	0	0	0	0	0	2.0263	0	0	0	0	0
rmse	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
sigma	0.636255	0.665497	0.67135	0.672252	0.667089	0.67141	0.670826	0.670305	1.88439	0.571097	0.622227	0.641219	0.636255	0.627871
S1/S0	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.20	0.30	0.40	0.60	0.80	1.00
S0	500,000													
R0	701976	701976	701976	701976	701976	701976	701976	701976	701976	701976	701976	701976	701976	701976
steepness	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95	0.25	0.25	0.25	0.25	0.25	0.25
Fmsy	0.016	0.042	0.066	0.088	0.109	0.131	0.155	0.181	0.016	0.016	0.016	0.016	0.016	0.016
SSBmsy	237831	218667	203521	190673	179203	168535	158214	147823	237831	237831	237831	237831	237831	237831
Fratio	0.05	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.27	0.12	0.06	0.05	0.04
SSBratio	1.43	1.95	2.24	2.46	2.63	2.84	3.04	3.27	0.00	0.26	0.61	1.10	1.43	1.68

Appendix Table O.10 NEFSC spring survey index(kg/tow), total catch ('000 mt), 3yr moving average of spring survey biomass index, relative exploitation rate (catch/ 3yr average of spring survey biomass index) for ocean pout, 1968 – 2007. With vessel conversion factors applied.

Year	NEFSC Spring Index kg/tow	Total Catch ('000, mt)	3 year moving average (kg/tow)	Exploitation ratio (catch/ 3yr avg index)
1968	5.446	16.4998	5.800	2.845
1969	6.154	30.0671	5.581	5.387
1970	5.143	9.9074	4.497	2.203
1971	2.195	7.9093	3.934	2.011
1972	4.463	4.8327	3.137	1.541
1973	2.753	6.6499	2.898	2.294
1974	1.479	4.8535	1.842	2.635
1975	1.293	0.9857	1.314	0.750
1976	1.170	1.1945	1.975	0.605
1977	3.461	1.9770	2.667	0.741
1978	3.371	2.3976	2.643	0.907
1979	1.096	2.1649	2.933	0.738
1980	4.333	2.3441	3.559	0.659
1981	5.247	2.9646	4.284	0.692
1982	3.273	4.7408	4.252	1.115
1983	4.236	4.8926	4.350	1.125
1984	5.540	5.0166	5.423	0.925
1985	6.494	4.6648	6.126	0.761
1986	6.345	4.0957	5.175	0.791
1987	2.686	4.8075	4.092	1.175
1988	3.244	4.0533	2.619	1.548
1989	1.926	9.9463	2.890	3.441
1990	3.501	11.4462	2.679	4.272
1991	2.610	7.6530	2.789	2.744
1992	2.257	2.2983	2.650	0.867
1993	3.084	1.8053	2.311	0.781
1994	1.593	1.9106	2.198	0.869
1995	1.916	0.7503	1.856	0.404
1996	2.058	0.8110	1.869	0.434
1997	1.632	0.6067	1.808	0.336
1998	1.733	0.8153	1.975	0.413
1999	2.561	0.9449	2.103	0.449
2000	2.016	0.4094	2.458	0.167
2001	2.798	0.5952	2.280	0.261
2002	2.025	0.6237	2.242	0.278
2003	1.903	0.4966	1.491	0.333
2004	0.546	0.3687	0.992	0.372
2005	0.526	0.2789	0.533	0.523
2006	0.526	0.2353	0.510	0.462
2007	0.477			
2008				
time series average	2.94	2.94	1.25	
time series median	2.61	2.65	0.78	
1980-91 median		4.17	1.12	
1977-1985 median		4.25	0.76	

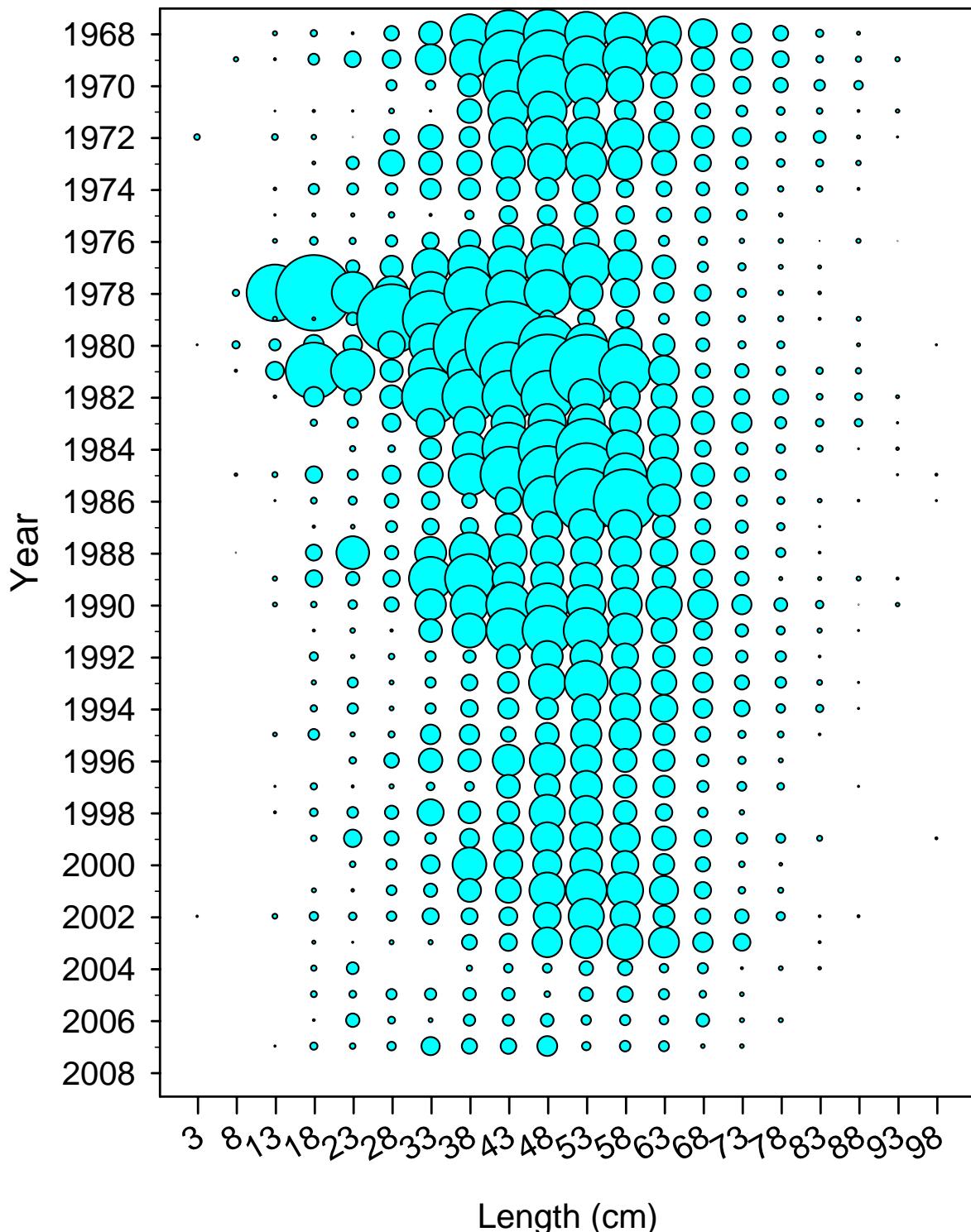


Appendix Figure O.1 Trends in mean catch per tow, in numbers and weight (kg) for ocean pout in the NEFSC winter survey, 1992 – 2007.



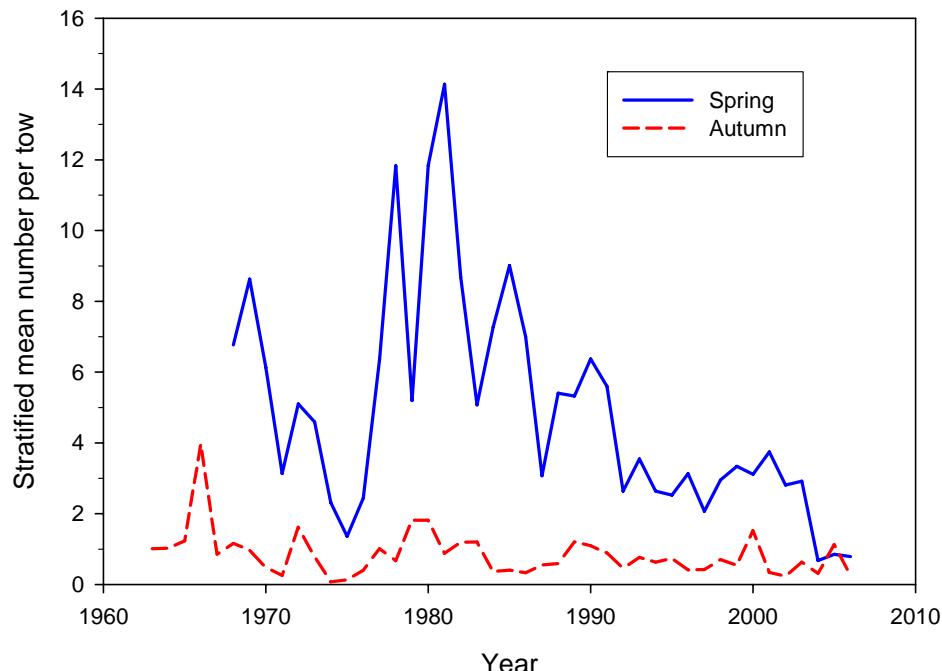
Appendix Figure O.2 Trends in mean catch per tow, in numbers and weight (kg) for ocean pout in the Massachusetts inshore survey, 1978 – 2007.

Ocean Pout



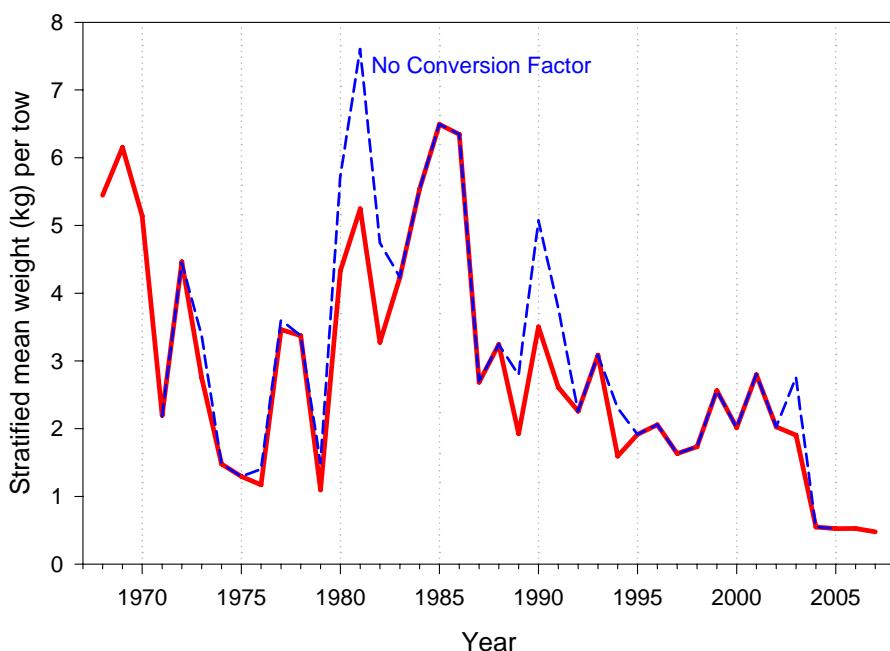
Appendix Figure O.3. Stratified mean number per tow at length of ocean pout from the NEFSC research vessel spring survey, 1968 to 2007, binned into 5 cm intervals.

Ocean Pout NEFSC surveys



Appendix Figure O.4. Stratified mean number per tow of ocean pout from NEFSC spring and autumn bottom trawl surveys, 1963 – 2006.

Ocean pout NEFSC spring index With and without vessel conversion factors



Appendix Figure O.5. Stratified mean weight (kg) per tow of ocean pout from NEFSC spring survey, 1968 – 2007, with and without vessel conversion factors applied.

[Note: R/V Delaware II underwent a refit in 1997].

Appendix Figure O.6. Trends in relative biomass, total catch, fishing mortality rate indices (catch / survey index) and replacement ratios for ocean pout. Relative F is computed as catch in year t divided by a 3 yr average of indices in year t-1, t, and t+1.

